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noted that the invention is equally applicable to other steel components wherein shrinkage of the weld during cooling causes residual stress or distortion.

[0028] In addition, many modifications may be made to adapt a particular situation or material to the teachings of the invention without departing from the scope of the invention. Therefore, it is intended that the invention not be limited to the particular embodiments disclosed herein, but that the invention will include all embodiments falling within the scope and spirit of the appended claims.

What is claimed is:

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1. A filler metal for use in welding steel comprising:
 - not more than about 0.1% C;
 - not more than about 1.0% Si;
 - not more than about 0.8% Mn;
 - from about 10.5% to about 13.0% Cr;
 - from about 0.65% to about 4.0% Ni;
 - from about 10(% C) to about 1.5% Ti;
 - not more than about 0.5% each of N, S, P, Mo, Nb, Cu, V, or Co; and
 - balance essentially Fe,wherein a weld test pad of said filler metal obtained in accordance with AWS A5.22, § 3.3 contains a microstructure comprising martensite.
2. The filler metal of claim 1 wherein said test pad has a martensite content from about 20-60% based on the volume of said test pad.
3. The filler metal of claim 1 wherein said filler metal comprises not more than about 0.6% Mn, from about 11.75% to about 12.75% Cr, from about 1.0% to 1.5% Ti, and from about 1.6% to about 2.2% Ni.
4. The filler metal of claim 1 wherein said filler metal comprises:
 - from about 0.05-0.07% C;
 - from about 0.4-0.6% Si;
 - from about 0.4-0.6% Mn;
 - from about 12.2-12.3% Cr;

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from about 0.2-0.4% Mo;

from about 1.2-1.3% Ti;

from about 0.01-0.03% P;

from about 0.01-0.02% S; and

from about 2.0-2.2% Ni.

5. The filler metal of claim 4 wherein the filler metal comprises from about 0.05-0.15% N.

6. The filler metal of claim 5 wherein the filler metal comprises from about 0.05-0.15% Cu.

7. The filler metal of claim 1 wherein the filler metal, when melted and cooled, forms austenite during solidification and said austenite transforms to martensite during cooling with an accompanying expansion in volume.

8. A method of attaching together two components comprising the steps of:

a) providing a first component;

b) providing a second component;

c) placing a filler metal between said first component and said second component; and

d) welding the filler metal to form a weld between said first component and said second component thereby attaching together said components;

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wherein said weld comprises an amount of martensite sufficient to increase the volume of the weld thereby at least partially offsetting shrinkage of the weld upon cooling.

9. The method of claim 8 wherein said weld comprises from about 20-60 percent martensite based on the total volume of the weld.

10. The method of claim 8 wherein said weld comprises from about 30-40 percent martensite based on the total volume of the weld.

11. The method of claim 8 wherein said filler metal comprises:

not more than about 0.1% C;

not more than about 1.0% Si;

not more than about 0.8% Mn;

from about 10.5% to about 13.0% Cr;

from about 0.65% to about 4.0% Ni;

from about 10(% C) to about 1.5% Ti;

not more than about 0.2% N;

not more than about 0.04% P;

not more than about 0.03% S;

not more than about 0.5% Mo, Nb, Cu, V, or Co; and

balance essentially Fe.

12. The method of claim 11 wherein said filler metal comprises not more than 0.6% Mn, from about 11.75% to about 12.75% Cr, from about 1.0% to 1.5% Ti, and from about 1.6% to about 2.2% Ni.

13. The method of claim 12 wherein said filler metal comprises:

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from about 0.05-0.07% C

from about 0.4-0.6% Si;

from about 0.4-0.6% Mn;

from about 12.2-12.3% Cr;

from about 0.2-0.4% Mo;

from about 1.2-1.3% Ti;

from about 0.01-0.03% P;

from about 0.01-0.02% S; and

from about 2.0-2.2% Ni.

14. The method of claim 8 wherein said first component comprises stainless steel and the second component comprises stainless steel or mild steel.
15. The method of claim 14 wherein said first component is a tube.
16. The method of claim 14 wherein said second component is a flange.
17. The method of claim 14 wherein the first component is an exhaust tube and the second component is a flange for use in an automotive exhaust system.
18. The method of claim 8 wherein step d) comprises welding the filler metal using a gas metal arc welding process.
19. The method of claim 8 wherein step d) comprises:

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melting at least a portion of each of the filler metal, the first component and the second component thereby forming a puddle of molten steel which solidifies and cools to form the weld.

20. The method of claim 19 wherein austenite forms in the puddle of molten steel as it solidifies and the austenite transforms into martensite with an accompanying expansion in volume as the puddle cools.

21. The method of claim 20 wherein said weld comprises from about 20-60 percent martensite based on the total volume of the weld.

22. The method of claim 21 wherein said weld comprises from about 30-40 percent martensite.

23. A welded article made according to the method of claim 8.

24. A welded stainless steel article comprising:

a first low carbon stainless steel component welded to a second low carbon steel component by a stainless steel weld material located in a weld joint between the first and second components wherein the weld joint comprises from about 20-60 percent martensite by volume.

25. The article of claim 24 wherein said first component is an exhaust tube and said second component is a flange.

26. The article of claim 24 wherein said stainless steel weld material comprises not more than about 0.1% C, from about 8.0 - 13.0% Cr, and from about 0.30 - 4.0% Ni by weight.

27. The article of claim 26 wherein said first low carbon stainless steel component comprises not more than about 0.10% C, from about 10.5-13.0% Cr,

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and not more than about 0.6% Ni and said second low carbon steel component comprises not more than about 0.09% C, not more than about 0.15% Cr and not more than about 0.15% Ni.